Mount Rainier National Park
Science Brief

National Park Service
U.S. Department of the Interior

Mount Rainier National Park

Climatic and Human Influences on the Fire and Vegetation History of Subalpine Meadows- Mount Rainier National Park

Importance

Subalpine meadows of Mount Rainier National Park (MORA) are by far the most frequented areas of the park. Visitors are drawn by the astounding array of wildflowers and the breathtaking views of the mountain. As a result of their popularity, many of the park's subalpine meadows have been severely degraded over the past 100 years, mainly from off-trail hiking and camping that leads to the trampling of vegetation and hillslope erosion. Since the 1980s, restoration efforts (most notably in the Paradise meadows area) have repaired much of the damage, and efforts to preserve the park's lesser-disturbed subalpine meadows have been at least partially successful at preventing further damage. Today, however, a very different phenomenon threatens the future of MORA's subalpine meadows; tree encroachment. It is clear from historical photos that during the last century, trees (primarily subalpine fir [*Abies lasiocarpa*]) have gradually migrated upslope into subalpine meadows. The underlying cause of this encroachment, however, remains unclear.

The lack of 20th century fires in subalpine meadows may be to blame for tree encroachment into subalpine meadows. Periodic fire is needed to curb seedling establishment in meadows and prevent treeline (the upper elevation at which trees grow) movement upslope. As the result of 20th century fire suppression, fire has been all but excluded from MORA since its establishment in 1899, including fire in the park's meadows. The frequency and intensity of pre-historic fires in subalpine meadows is generally unknown, and perhaps more importantly, it remains unclear whether lightning or human-set fires were the primary source of fire ignitions in the park's subalpine meadows prior to Euro-American settlement.

It is now widely accepted that humans have inhabited the PNW for the last 13,000 years, if not longer. Recent archaeological efforts in MORA show that Native Americans were living in the area as early as 9500 years before present, and the findings suggest intensive use of subalpine and alpine areas for resource extraction (i.e., hunting, berry gathering). Numerous ethnographic and ecological studies from MORA and similar areas of the Pacific Northwest discuss the use of fire in subalpine meadows by Native Americans as a way to increase berry harvests, herd game, improve hunting visibility, and clear frequently used trails. With the decline of Native American populations due to disease and displacement in the early to mid-1800s, and the success of fire suppression efforts in the Pacific Northwest starting ca. AD 1900, the loss of frequent and intentionally-set fires in

MORA may have been the impetus for tree establishment in subalpine meadows. Many researchers are now exploring the idea that Native Americans were the primary ignition source for fire in the Pacific Northwest prior to Euro-American settlement, not only in subalpine meadows, but also in many other lower-elevation ecosystems.

Reconstructing Fire History: Lakes that sit within the subalpine zone of MORA provide an opportunity to reconstruct past changes in fire activity and vegetation. Charcoal, which is the by-product of the incomplete combustion of plant material, and pollen, which is the male gametophyte of seed-producing plants, are continuously incorporated into lake sediments. The extraction of vertical sediment cores where the top of the core preserves present day conditions and deeper is progressively older, allows for a reconstruction of the former environments that extend several thousand years into the past. Change in the abundance of charcoal particles through time is used as an indicator of past fire activity (i.e., how often an ecosystem burned), while variation in the type and abundance of different pollen grains is used as an indicator of past vegetation change (i.e., how plant species changed near a site).

In August 2011, researchers and students from the Geography Department at Central Washington University collected lake sediment cores from three lakes in the Sunrise Area of MORA: Shadow Lake, Sunrise Lake, and Little Sunrise Lake. Cores are retrieved using and hand-operated piston device lowered from a floating platform anchored in the middle of the lake (see photo). The cores recovered are unique in that they are the oldest known sediment cores obtained from MORA. The age of the cores is mainly known from the presence of volcanic ash layers contained within the sediments (see photo). The Shadow and Sunrise lake cores both spanned the last 10,000 years. Charcoal and pollen assemblages contained within the cores are currently being analyzed in the Paleoecology Lab at Central Washington University, and will be used to determine past fire activity and vegetation pattern at the three study sites. A comparison of the fire and vegetation records with local archaeological records will help determine the likelihood that human use of fire contributed to pre-historic fire regimes in MORA.

Discussion: Beyond providing information on past fire regimes and contributing to the discussion of whether humans or climate predominantly controlled fire in subalpine meadows during the last several thousand years, this study will provide site-specific information that can be used in making local land management decisions in accordance with the MORA Fire Management Plan (2005). Fire histories developed through this study will offer physical evidence of historical conditions that can be compared with modern conditions to evaluate the need for active management of subalpine meadows (i.e., prescribed burning). Furthermore, vegetation reconstructions developed through this study will provide an historical context for evaluating the conversion of subalpine meadows to closed subalpine forest over a much longer timescale than what is provided by historical accounts and tree-ring based analyses. In addition to informing park management decisions, this study will contribute significantly to an ongoing regional assessment of the dominant controls of fire activity and vegetation change in the Pacific Northwest during the last several thousand years. Knowledge of historical fire activity during this time period is especially needed to improve assessments of current and future

climate change, brought about by rising greenhouse gas concentrations in the atmosphere, and facilitate more informed management decisions regarding future wildfire threats. A better understanding of how fire activity in subalpine forest/meadow ecotones reacted to past climate change could allow land managers to develop plans to confront changing fire activity that will almost certainly accompany future climate change.

Researchers and students from Central Washington University retrieving a lake sediment core from Sunrise Lake, Mt Rainier National Park, August 2011. Photo credit: Rich Villacres.

Lake sediment core from Sunrise Lake showing volcanic tephra layers from Mt. Rainier and Mt. St. Helens eruptions. Photo credit: Megan Walsh